DOCUMENT RESUME

ED 427 657 IR 019 176

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TITLE The Web as Process Tool and Product Environment for Group-Based Project Work in Higher Education.
PUB DATE 1996-10-00
NOTE 7p.; In: WebNet 96 Conference Proceedings (San Francisco, CA, October 15-19, 1996); see IR 019 168.
AVAILABLE FROM Web site: http://aace.virginia.edu/aace/conf/webnet/html/378.htm
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Class Activities; *Computer Assisted Instruction; Computer Mediated Communication; *Cooperative Learning; Course Evaluation; Distance Education; Educational Technology; Foreign Countries; *Group Activities; *Higher Education; Information Technology; Instructional Design; Problems; *Student Projects; Teaching Methods; *World Wide Web
IDENTIFIERS Business Information; Collaborative Learning; *Learning Environments; University of Twente (Netherlands)

ABSTRACT

This paper discusses problems confronting the use of group-based project work as an instructional strategy in higher education, and describes two technical courses (i.e., courses in online learning and applications of business information technology) at the University of Twente (Netherlands) in which course-specific World Wide Web environments are used both as tools for group-process support and as the product environment of the project work. The focus is on Web-embedded shared workspace, communication management, evaluation tools, and their contribution to the management of group-based project work. It is argued the both pedagogical and technical strategies are needed for efficient and effective support of group-based project work in higher education. A table highlights particular strengths of the courses in relation to persistent problems in the educational deployment of group-based project work. (Author/DLS)

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ED 427 657

# The Web as Process Tool and Product Environment for Group-Based Project Work in Higher Education

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**Abstract:** We discuss problems confronting the use of group-based project work as an instructional strategy in higher education and describe two courses in which course-specific Web environments are used both as tools for group-process support and as the product environment of the project work. In particular we describe specific Web-embedded shared workspace, communication management and evaluation tools and their contribution to the management and educational value of group-based project work. We argue that both pedagogical and technical strategies are needed for efficient and effective support of group-based project work in higher education.

## Introduction: Group-Based Project Work as an Educational Strategy

Group-based project work, or project-based education, is a form of instructional organization with a long history. It can take many forms, varying on key dimensions such as the degree of openness in the problem being addressed via the project activities, the choice of individual or group engagement as the mode for carrying out project activities, and the relationship of the project to the course in which it is situated. For our own work, we define project work in the university context as involving groups of students who must collaborate or at least co-operate in the execution of a multi-phase activity designed to embody the learning goals of a course and involving at least the stages of problem analysis, decision making about approach choices to problem-related actions, design and production of problem-related output, and iterative evaluation of output in relation to the original problem and the goals of the course.

## Key Variables and Research Questions Relating to Group-Based Project Work

Within these phases of project work, many different variables influence the educational value of the experience and certain key problems repeatedly occur. Project work involves process as well as product; process must be managed both internally and externally, with attention to efficiency and group memory; group-interaction variables affect both process and product; and the product of project work must fit the problem or needs that stimulated the project activity. All of these are complex tasks, particularly for the instructor also involved in the execution of the project activity as part of a broader course experience. When some or all of project-work activity takes place among participants distributed over time or distance, the challenges involved in making project work a productive and manageable instructional strategy increase [Collis & Smith 1996]. A general question of broad interest is thus:

*Which pedagogical and management strategies, combined with which Web-integrated functionalities, improve the efficiency and educational effectiveness of group-based project work for university students in design-oriented technical courses where members of the courses include students from different*

IR019176

*countries and educational institutions?*

Two courses in which we are involved and which make project work a key instructional strategy are serving as cases for us in our on-going examination of this question, both to improve our own teaching and in relation to a joint research focus on "tele-learning" involving both of our faculties at our university. In this paper, we describe the 1995 versions of these two courses, one for educational technology students and the other for business information technology students; indicate some key problems addressed by (ourselves as) the instructors of these courses; describe the Web-based tools and environments designed and used by the instructors within the courses in support of the project work; and reflect critically on future refinements in project-work deployment in our courses

**Description of the Courses**

The course *On-Line Learning* is an elective course for senior students in the Faculty of Educational Science and Technology at the University of Twente in The Netherlands. Students electing the *On-Line Learning* course generally are specializing in the design and development of electronic instrumentation for learning support. In the 1995 version of the course, there were 32 students including five exchange students from Spain and Germany. Relating directly to the objectives for the course is a collaborative learning activity, around which the project work is based. In 1995 this collaborative learning activity was the design and development of a hyperlinked reader making effective use of the functionalities available in the World-Wide Web environment.

The Jigsaw Methodology for collaborative work was employed, by which each member of a group has a specific task which must be contributed in an appropriate fit to the overall "jigsaw" of the project [see, for example, McManus & Aiken 1995]. In the groups of three, all group members had to agree on the structure and global design decisions for their component of the communal Web site, but after this it generally proceeded that one student took the lead for the actual technical development of the site, one for the content, and one for design decisions relating to layout and navigation. The instructor managed the project work through a mixture of computer conferencing using the FirstClass computer conferencing environment, e-mail, and distribution-list communication. Over 500 messages were logged during the course. It was required that all group-produced components be integrated into the "new textbook" as a total learning resource and that the entire environment be completed and presented (to the class and to the "world" via its movement to a WWW server for Internet access) during the final face-to-face session of the course. The product of this project work can be seen within the 1995 course site, at

*URL http:// www.to.utwente.nl/ism/online95/campus/campus.html*

*Applications of Information Technology* (*AIT*) is a compulsory course for first-year students in Business Information Technology (BIT) at the University of Twente (the Netherlands). The Business Information Technology curriculum started in 1993 to bridge the gap between computer science and business administration. *AIT* makes this very explicit, by using information technology to study applications of information technology. *AIT* provides an introduction to the full spectrum of applications of information technology, allowing students to zoom in on specific applications. The course emphasizes the role of the technology in organizations rather than the technology itself. Thus, the course serves to motivate the students for what is coming in the remaining curriculum and makes sure that they can relate theory to practice. A special feature of the course is the experience of working collaboratively on the major course project with students taking a similar course at the Kuopio Vocational Educational Centre in Finland via the Internet.

Students work in project groups each of which consists of about six Dutch and three Finnish students. Each group has its own Web page that gives an overview of the group's work. Efforts of the group are to yield a collaboratively produced report about a selected topic, in the form of a set of Web pages in which individual contributions are integrated. The individual contribution of each member of a project group consists of a page in which that member presents himself, and a number of pages in which the acquired knowledge is presented in the form of an essay. The course takes nine weeks each consisting of two sessions of four hours each. A group arranges its own work, making sure that the next week's

commitments are kept. Access to other equipment or access beyond hours is possible and may be necessary to achieve the desired goals. Tutorial sessions for the course stress the relation of the project to the content of the course textbook. Supervision contacts are maintained with each local subgroup, to check progress; to account for the commitments due; to stimulate improving the work; and to ensure that delivery of the final document is guaranteed. Self evaluation by the students is carried out electronically by means of an evaluation tool embedded in the course Web site.

After having successfully followed the course, students' knowledge of the role of information systems in organizations, failure and success factors of applications of information technology, information sources and Internet applications should have increased. Furthermore, students should be able to formulate an information request, to collect information, to use information technology for collaborative document processing and to co-operate effectively. International co-operation, taking initiatives in order to achieve goals, thinking critically and constructively and respecting the requirements from within an organization are other important aspects of the course.

**Use of Web-based Tools and Environments for Process Support in the *AIT* Course**

In the 1995 version of the *On-Line Learning* course described here, the Web was used as the platform for the products of collaborative work and well as the environment that was the focus of study of the collaborative work itself. However, the Web site for the course was intended more as the product and archive of the course rather than as a tool for supporting the process of project work during the course. Separate communication environments supporting various forms of communication and file transfer were the tools for this support. In the *AIT* course, the Web is used both as a management and work site and a product-related environment, although the product is realized more individually compared to the *Online Learning* course. Of particular process support in the *AIT* course are functionalities integrated within the course Web site relating to mail archive, to shared workspaces, and to evaluation tools. In the following, the functionalities of these features are described and their integration into the overall *AIT* course site explained. Thus we discuss these in some detail here.

A Web environment was created which was explicitly meant to be a starting point for students following the course. The same environment was available for both the Dutch and Finnish students to assure the same basic information. This Web environment served several purposes:

1. providing practical information of the course: planning, time schedules, goals and phases were available
2. providing local course information such as manuals, papers and an example of a Web environment created by one of the last year's *AIT* groups
3. supporting the information-search process (links to the local on-line library, Web search engines and electronic journals)
4. supporting both synchronous and asynchronous communication among both local and international group members, with other groups and with and among the tutors
5. providing feedback on communication by a group memory (mail archive) for every group
6. supporting collaborative document processing by integrating shared workspaces into the Web site
7. presenting the (intermediate) results and the end products (Home Pages)
8. supporting self evaluation by students through an embedded evaluation tool

The tools for purposes 5, 6, and 8 are further described.

***Mail Archives***:

Mail archives are designed to support the structured storage and retrieval of group mail messages. As such they function as the shared memory of the communication process between the group members. Messages sent to the archive are stored and distributed to the members of the archive. In *AIT*, every project group (including its tutors) has its own archive. The archive's Web interface allows its members to reply to messages already present. The interface has different modes, for example, messages can be ordered by thread, by subject, by date, and by sender.

***Shared Workspaces***:

Shared workspaces are environments for collaborative document processing. The tool used in the *AIT* course is *BSCW, Basic Support for Co-operative Work*, developed by the GMD Institute (German National Research Centre for Computer Science) in Bonn, Germany. BSCW supports the storage of several different kinds of documents such as texts, pictures, hypertexts, audio and video. It is Web-based so using the environment is platform-independent. Every group has its own workspace. BSCW keeps track of the events in the workspace, such as adding, reading, and updating documents and of the agents involved in those events. Features such as version management and file locking are also available.

***Evaluation Tool***:

An evaluation tool has been developed to support evaluation of the course by all students. The tool is integrated in the Web environment of the course. It consists of three components. The first is a questionnaire with 41 five-point Likert scale items that must be filled out and electronically submitted. The second component processes the data after receipt; several statistical analyses are possible but in *AIT* basic measures like frequency and median are used and histograms are created. The third part of the tool consists of the HTML document used to graphically present the evaluation results. More specifically, histograms show the absolute frequency of each score per item (split per nationality, Dutch or Finnish) and the median scores of all items (also split per nationality). Shortly after submitting the form, the graphical representations of the results can be accessed via a hyperlink.

**Key Strengths and Problems in the Project Work**

Although the courses have been positively evaluated by their students and instructors [see Bos, Morgan, & Kikstra 1996], [van Diepen & Pouw 1995] and [Pouw, Terlouw, Joosten, & van Diepen 1995], they highlight on-going problems as well as satisfactions in the use of group-based project work as an educational strategy. We indicate some of the major satisfactions and some of the major problems.

In the *On-Line Learning* course, key satisfactions came from the close collaboration and interdependency both within and between the groups, the ease with which the local Web environment allowed each group to see the evolving work of the other groups and use this as the basis for coming to consensus about key design decisions for the overall product. The students came to call the Web site their construction area and their "virtual campus", and gave themselves their own "rooms" (their metaphor for their home pages) and "living areas" (their metaphor for areas under construction. A number of these metaphors are shown and discussed in the site itself, via the link "Our Environment" from the homepage). The sense of common ownership of a product by 33 students was linked to a positive learning dynamic in the course [Collis 1996].

Some problems however did occur with the project work in the *On-Line Learning* course, particularly with respect to the efficient and effective management of project work, such as organization of group resources, the extraction and organization of key materials for a "group memory" for each project group that could be shared not only by each set of group members but also by the instructor and members of other groups. The text-based computer conferencing environment, on a separate server and highly constrained in the type of file it could handle from outside of its own message environment, lost its functional benefit even for asynchronous communication as more and more project-work communication came to be related to HTML and graphics files and ideas from other WWW sites.

In the *AIT* course, key satisfactions and problems in the management of project work occurred in several ways. The main satisfactions concerning the management of the project were the students' insights into the possibilities and limitations of international group-based project work, the integrated Web environment and the automatic evaluation tool. The Web environment in which starting points for communication, information search, collaborative document processing, presentation and evaluation were integrated, appeared to be very useful.

Although international co-operation was more successful in 1995 than in 1994 some problems remained. Learning goals must be shared by all group members However, Finnish students regarded the course as

less relevant than Dutch students. This seems to be related to the different status of the course in the respective curricula and to the different student populations in the institutes involved. Differences in cultural and social background, educational system, mother tongue and motivation may cause problems in reaching the same learning goals. Especially in time-critical situations, e-mail as an asynchronous medium did not fulfill the communication needs in *AIT*. Furthermore, we experienced that BSCW, the tool we introduced for stimulating collaboration, was not very frequently used for this purpose.

**Combining the Strengths**

In terms of more generic applications to the improvement of group-based project work in higher education, the two courses both suggest the use of an integrated electronic work area employing functionalities such as those available in the Web combined with an effective pedagogy. Table 1 highlights particular strengths of the courses in relation to persistent problems in the educational deployment of group-based project work (note that a comment given in relation to one course does not imply its absence in the other course, only its relative dominance).

| **Persistent Problem in Group-Based Project Work** | **Contributions from the *On-Line Learning* course** | **Contributions from the *Applications of Information Technology* course** |
|---|---|---|
| Problems in maintaining course cohesion and momentum as students become immersed in their respective projects | Communal design and construction of the course Web site, accessible to all and making group progress visible to all | |
| Problems in motivating and structuring collaboration | Choice of a task (communal development of a common product) and instructional strategy (the Jigsaw Methodology, whereby each group member has clear and separate contributions to the group) | Choice of the strategy of combining local and distant members in each group (in this case, Dutch and Finnish students) |
| Problems in motivating and structuring communication | Strategy of having a rapporteur in each group responsible for responding to the instructor during weekly "on-line activities" structured by the instructor | Use of the mail archive integrated in the course Web site |
| Problems in maintaining a "group memory" | | Use of the shared workspace functionality integrated in the course Web site |
| Problems in organizing and executing self- and intergroup evaluation | Use of a Web site as the product as well as the process environment allowed convenient opportunities for inter-group comparisons and discussions as well as evaluation based on overall collaborative results | Use of the evaluation tool integrated in the Web site allowed efficient registration of student feedback, immediate comparison among subgroups of students, and immediate visualization to the student of the similarities or differences in his impressions of the course and those of his local and distant coursemates |

**Table 1:** Improving the Efficiency and Effectiveness of Group-Based Project Work: Contributions from the Two Courses

**Further Directions**

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The combination of strengths suggested in Table 1 is being put into practice in our two courses in their 1996 versions. The *On-Line Learning* course, 1996 variant, made extensive use of the BSCW shared workspace and an integrated WWW environment, no longer using FirstClass and a separate mailing system. The 1996 course can be seen at:

*http://www.to.utwente.nl/ism/online96/campus.htm*

In the 1996 *AIT* course, the communal design of the Web site will be stimulated by applying Jigsaw methodology, also used in the *On-Line Learning* course. Furthermore, communication will be structured by the use of protocols.

We are also actively involved in research issues relating to the support of project work through the combination of appropriate pedagogy and technology. Areas of particular interest in our research include tailoring "group memory" and optimizing communication in terms of both quality and quantity.

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